PATENT COOPERATION TREATY

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing *(day/month/year)*	22 June 2005 (22.06.2005)
Applicant's or agent's file reference: PIA41179/PSC	FOR FURTHER ACTION: See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority Date *(day/month/year)*
PCT/KR 2005/000847	23 March 2005 (23.03.2005)	25 March 2004 (25.03.2004)

International Patent Classification (IPC) or both national classification and IPC
H01S 5/18

Applicant
POSTECH FOUNDATION

1. This opinion contains indications relating to the following items:

- [x] Cont. No. I — Basis of the opinion
- [ ] Cont. No. II — Priority
- [ ] Cont. No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Cont. No. IV — Lack of unity of invention
- [x] Cont. No. V — Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- [ ] Cont. No. VI — Certain documents cited
- [ ] Cont. No. VII — Certain defects in the international application
- [ ] Cont. No. VIII — Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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Continuation No. I

Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed.

Continuation No. V

Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims **1-13**	**YES**
	Claims **----**	**NO**
Inventive step (IS)	Claims **1-13**	**YES**
	Claims **----**	**NO**
Industrial applicability (IA)	Claims **1-13**	**YES**
	Claims **----**	**NO**

2. Citations and explanations:

The following four documents have been cited in the Search Report :
D 1 : US2002/024980 - A1
D 2 : US 5345462 – A
D 3 : US 5343490 – A
D 4 : US 5363393 – A

D 1 : US 2002/024980 A1 relates to a 3 dimensional (3D) whispering gallery (WG) photonic quantum ring (PQR) laser diode with an ultra-low threshold current. An active region (18) which radiates light three dimensionally with different wavelengths is provided in between N-type multilayer distribution reflector (16) and P-type multilayer distribution reflector (20). The specific area of active region restricts the radiation by cyclic Rayleigh constraint in flat surface. A strip-like P-type upper electrode is formed on preset area on the active region. The active region comprises lower portion AlxGaAs spacer layer (17) and upper part AlzGaAs spacer layer (19) of high and low band gap energy, where x and z varies from 0-1. The N-type and P-type multilayer distribution reflector has different refractive index.
A photonic quantum ring (PQR) laser diode with a plurality of laterally extending layers, one on top of another in an axial stack, comprises an active region sandwiched between an n-type multi-layer distributed Bragg reflector (DBR) stack and a p-type multi-layer DBR stack, wherein, along the circumference of said active region, 3 dimensional radiations are emitted with various wavelengths over a predetermined tuning range, as a function of slanted view

angle with respect to the stack axis. The PQR laser shows an ultra-low threshold current of microampere range.

D 2 : US 5345462 – A relates to a semiconductor surface emitting laser having enhanced polarization control and transverse mode selectivity. The laser comprises a transversely configured active region longitudinally sandwiched between a pair of reflecting layers. The active region having a transverse cross section with a center. The transversely configured active region has a major dimension constituting the longest line segment in the region passing through the center and a minor dimension constituting the longest line segment perpendicular to the major dimension in the region. The major dimension exceeds the minor dimension by a factor of 1.2 or more. The active region has a rhomboidal shape having an associated pair of diagonals with the major dimension along one diagonal and the minor dimension along the other diagonal.

D 3 : US 5343490 – A relates to a whispering mode micro-resonator. This device for electromagnetic emission depends on total internal reflection-on whispering gallery mode cavitation about the periphery of a disk-shaped element of sub-wavelength thickness. As a laser, operating above threshold, the design is alternative to that of the Surface Emitting Laser for integration in integrated circuitry-either all-optic or electro-optic. Operating below threshold, it may serve as a Light Emitting Diode. The same operational considerations-based on improved efficiency for whispering gallery mode devices as due to relevant dimension/s of sub-wavelength thickness-is of consequence for a category of devices serving other than as simple emitters.

D 4 : US 5363393 – A relates to a surface emitting semiconductor laser. This laser of a laminated structure having at least a light emitting active layer sandwiched between a dielectric film multi-layer mirror and a p-type semiconductor multi-layer mirror on a semiconductor substrate. The energy DELTA Ec of conduction band discontinuity is higher than the energy DELTA Ev of valence band discontinuity between at least two kinds of semiconductor layers with different refractive indices constituting the p-type semiconductor multi-layer mirror. On the other hand, the energy DELTA Ev of valence band discontinuity is higher than the energy DELTA Ec of conduction band discontinuity between at least two kinds of semiconductor layers with different refractive indices constituting the n-type semiconductor multi-layer mirror.

First cited document US 2002 / 024980 – A1 is equivalent to US – Patent Nr. 6519271 – B2 cited on page 3 (paragraph 19) of the description to show the state of the art. US 2002 / 024980 – A1 is earlier published on Feb. 28, 2002 than the US 6519271 - B2 (issued on Feb. 11, 2003) which is incorporated to the description by reference. Also figures 1A and 1B of this citation and figs. 1 and 2 of this new application are identical, and also the patent applicant (Postech Foundation) and one of the inventors (Kwon) are the same. This first cited document relates to a relatively new 3 dimensional (3D) whispering gallery (WG) photonic quantum ring (PQR) laser diode with an ultra-low threshold current.
So it might be plainly known which article should be made better - to get a low power consumption display device (in comparison to such one using LEDs). The result is recited in the independent claims 1 and 9: namely, providing a PQR – laser with a sufficient small radius to adjust an intermode spacing (IMS) so that it has maximal value (claim 1) or to adjust the number of oscillation modes so that it has the number of 1 (ad claims 6, 9). So low power consumption is achieved. Neither in the first nor in the other three cited documents this problem is addressed or solved.

Thus, the subject matter of the application is new and inventiveness is also given.
Industrial applicability is given, too.